320.

THE ART OF DIALLING;

BY A NEW, EASIE, AND MOST SPEEDY WAY.

SHEWING,
HOW TO DESCRIBE THE
Houre-lines upon all ſorts of Plaines,
Howſoever, or in what Latitude ſoever Scituated:

As alſo,
To find the Suns Azimuth, whereby the ſight of
any Plaine is examined.

Performed by a Quadrant, fitted with lines
neceſſary to the purpoſe.

Invented and Publiſhed by SAMVEL FOSTER, Profeſſor
of Aſtronomie in *Greſham* Colledge.

LONDON,
Printed by *Iohn Dawſon* for *Francis Eglesfield*, and
are to be ſold at the ſigne of the Marigold
in Pauls Church-yard.
1638.

To the Reader.

READER,

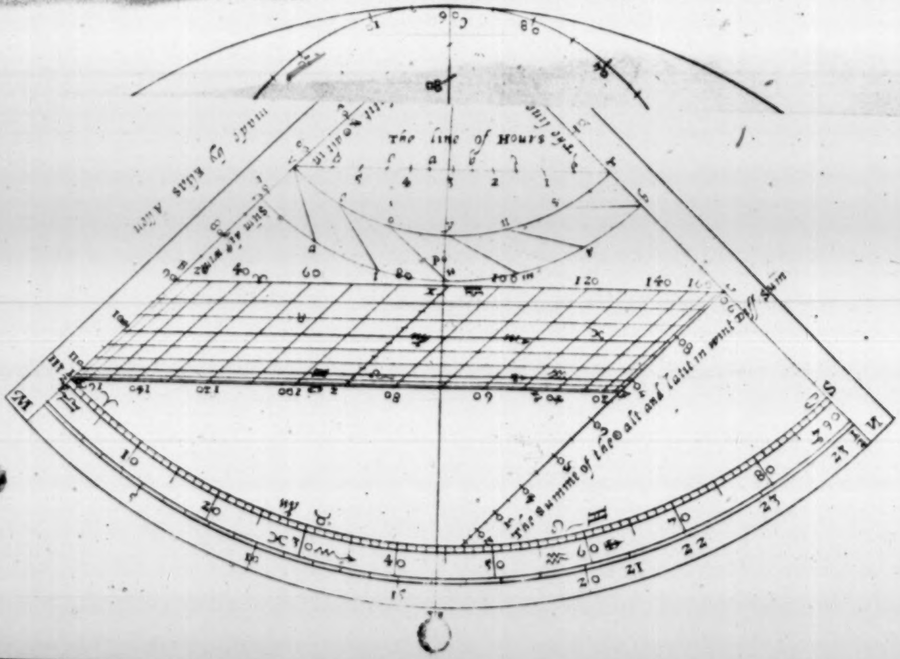
HEre is preſented to thy view a ſhort and plaine Treatiſe; it was written for mine owne uſe, it may become thine if thou like it; The ſubject indeed is old; but the manner of the Worke is all new. If any be delighted with recreation of this nature, and yet have not much time to ſpend, they are here fitted, the inſtrument will diſpatch preſently. If they feare to loſe themſelves in a wilderneſſe of lynes, or to outrunne the limits of a Plaine, by infinite excurſions (two inconveniences unto which the common wayes are ſubject) they are here acquitted of both, having nothing to draw but the Diall it ſelfe, contracted within a limited equicrurall triangle. If want of skill in the Mathematicks ſhould deterre any from this ſubject, let them know that here is little or none at all required, but what the moſt ignorant may attaine. If others ſhall thinke the Canons more exact; ſo doe I, but not ſo eaſie to bee underſtood, not ſo ready for uſe, not ſo ſpeedy in performance, nor ſo well fitting all ſorts of men : and withall an inſtrument in part muſt bee uſed, this will doe all, and is accurate enough. If it muſt needs be diſliked, let a better be ſhewed and I will diſlike it too ; It is new, plaine, briefe, exact, of quicke diſpatch. Accept it, and uſe it, till I preſent thee with ſome other thing, which will bee ſhortly.

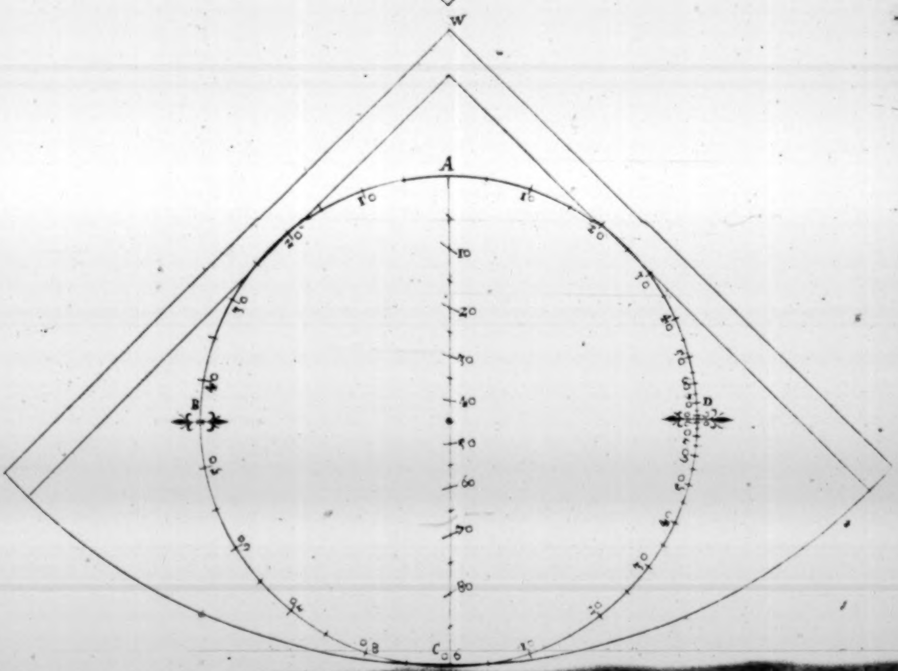
inſtrument will diſpatch preſently. If they feare to loſe themſelves in a wilderneſſe of lynes, or to outrunne the limits of a Plaine, by infinite excurſions (two inconveniences unto which the common wayes are ſubject) they are here acquitted of both, having nothing to draw but the Diall it ſelfe, contracted within a limited equicrurall triangle. If want of skill in the Mathematicks ſhould deterre any from this ſubject, let them know that here is little or none at all required, but what the moſt ignorant may attaine. If others ſhall thinke the Canons more exact; ſo doe I, but not ſo eaſie to bee underſtood, not ſo ready for uſe, not ſo ſpeedy in performance, nor ſo well fitting all ſorts of men : and withall an inſtrument in part muſt bee uſed, this will doe all, and is accurate enough. If it muſt needs be diſliked, let a better be ſhewed and I will diſlike it too ; It is new, plaine, briefe, exact, of quicke diſpatch. Accept it, and uſe it, till I preſent thee with ſome other thing, which will bee ſhortly.

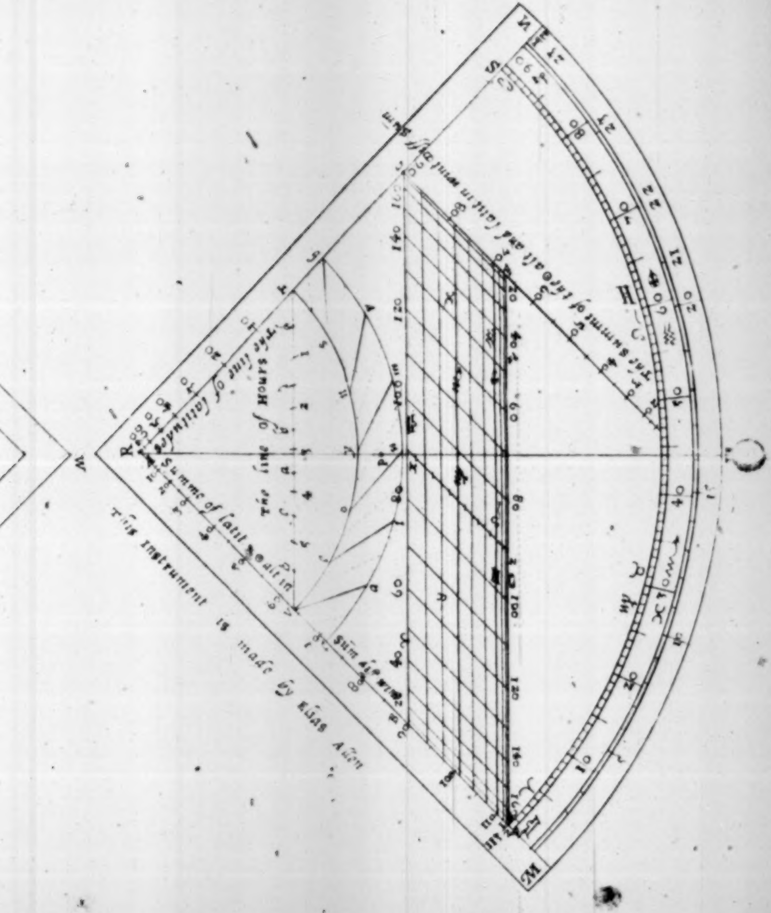
Imprimatur.

Decemb. 1.
1637.

S A. B A K E R.


The line of Hours
The line
made by Elias Allen
The Summe of the ⊙ alt and Latit in wint Diff Sum
Sum
S
N
W


W
A
B
C
D


The line of latitudes
The line of Hours
Summe of latit and dif in
The summe of the ☉ alt and latit in wint diff sum
Sum dif mint
This instrument is made by Elias Allen
R
S
W
N
M
A
a
10
20
30
40
60
80
100
120
140
160
27
22
21
20

Sum Sampsonis Mltin pt: 00 01 00

THE DESCRIPTION OF THE QVADRANT,
and the manner how the lines are inſcribed and divided.

CHAP. I.
1. *The deſcription of the fore-ſide.*

THe limbe is divided into 90 degrees, and ſubdivided into as many parts as quantity will give leave. The manner of diviſion, and diſtinction of the ſubdivided parts is ſuch as is uſuall in all other Quadrants.

To deſcribe the other Worke in the ſuperficies; Take from the upper edge of the limbe about 3 degrees, and ſet off that ſpace from the center R to A.

Then divide AE into ſeven parts, whereof let EB containe two. Or in greater inſtruments, if AE be 1000. let EB containe 285. Make SC equall to EB, and drawe the line BC. From C, draw CD parallel, and of equall length to AB. Upon AB and CD, and BE alſo (as farre as it is capable) inſert the 90 ſines, from B towards A and E, and from C towards D, but let them be numbred from A unto B to 90, and ſo to E 113 degrees 30 minutes, from D to C unto 90 degrees.

Againe: Draw ES cutting CD at F; ſo ſhall BCFEB containe a parallelogram, whoſe oppoſite ſides, being parallel, are divided alike, and in this manner. BE and CF as whole ſines, doe containe the 90 ſines, or as many of them as can diſtinctly bee put in: and from the diviſions are drawne parallel lines, having every tenth, or fifth, diſtinguiſhed from the reſt. Theſe ſerve for the 12 Signes and their degrees, and therefore you ſee upon every 30th degree, the characters of the 12 Signes inſerted, in ſuch manner as the figure ſheweth. And theſe lines may bee called, *The Parallels of the Suns place.*

In like manner, The lines BC, EF, being firſt biſected at X and Z, ſhall make 4 lines of equall length. Theſe 4 lines XB, XC, ZE, and ZF, are each of them divided as a ſcale of Sines, beginning at X and Z, and from each others like parts are parallel lines protracted, having every tenth and fifth diſtinguiſhed from the reſt. They are numbred; upon BC, from B to X 90, to C 180; upon FE, from F to Z 90, to E 180. Theſe lines are called, *The lines of the Sunnes Azimuth.*

This done; Upon the center R deſcribe the two quadrants VT, and BC, let their diſtance VC bee one ſixth part of Rc, or more if you will.

Divide them each into 6 equall parts, at e, o, y, n, s; and a, i, u, m, r, drawing ſlope-lines from each others parts, as Va, ei, ou, ym, nr, sb: and theſe lines ſo drawne are to bee accounted as Houres. Then dividing each ſpace into two equall parts, draw other ſlope-lines ſtanding for halfe houres, which may be diſtinguiſhed from the other, as they are in the figure.

Then from the points V and T draw the right line VT.

Laſtly, Having a decimall ſcale equall to TR, you muſt divide the ſame TR into ſuch parts as this Table here following alloweth, the numbers beginning at T, and riſing up to 90 at R.

Vpon your inſtrument (for memory and directions ſake) neere to the line AB, write, *The ſumme of the latitude and Sunnes altitude in Summer; The difference in Winter.*

Over VT, write, *The line of Houres.*

Neere to CD write, *The ſumme of the latitude and Sunnes altitude in Winter; The difference in Summer.*

By TR, write, *The line of latitudes for the delineation of Dialls.*

A Table to divide the line of Latitudes.

90	10000	62	9360	46	8259	30	6325	14	3325
85	9982	61	9311	45	8165	29	6169	13	3104
80	9924	60	9258	44	8068	28	6010	12	2879
78	9888	59	9203	43	7968	27	5846	11	2650
76	9849	58	9147	42	7865	26	5678	10	2419
75	9825	57	9088	41	7758	25	5505	9	2186
74	9801	56	9026	40	7647	24	5328	8	1949
72	9745	55	8962	39	7532	23	5146	7	1711
70	9685	54	8895	38	7414	22	4961	6	1470
69	9651	53	8825	37	7292	21	4772	5	1228
68	9615	52	8753	36	7166	20	4577	4	984
67	9578	51	8678	35	7036	19	4378	3	739
66	9519	50	8600	34	6902	18	4176	2	493
65	9496	49	8519	33	6764	17	3969	1	247
64	9454	48	8436	32	6622	16	3758	0	0
63	9408	47	8348	31	6475	15	3543		S.F.

2. *The deſcription of the backe-ſide.*

Upon the backe-ſide is a circle only deſcribed, of as large extent as the Quadrant will give leave, noted with ABCD, divided into two equall parts by the Diameter AC.

The ſemicircle ABC is divided into *90* equall parts or degrees, every fifth and tenth being diſtinguiſhed from the reſt by the longer line; They are numbred by 10, 20, 30, &c. unto *90*. The ſame parts are alſo projected upon the diameter AC, by a ruler applyed to them from the point D. Theſe are numbred alſo from A to C by 10, 20, &c. unto *90*.

The other ſemicircle ADC, is firſt divided into two Quadrants at D. And then upon theſe two quadrants are inſcribed 90 ſuch parts as this Table inſuing doth allow. The inſcription is made by helpe of a Quadrant of a circle equall to AD or CD, being divided into 45 equall degrees, out of which you may take ſuch parts as the Table giveth, and ſo pricke them downe, as the figure ſheweth. Every fifth and tenth of theſe parts is diſtinguiſhed from the reſt by a longer line; they are numbred from A and C, by 10, 20, &c. unto 90 ending in D.

A Table to divide the upper and nether Quadrants of the Circle.

1	1. 0	14	13.36	27	24.25	40	32.44	53	38.37	66	42.25
2	2. 0	15	14.31	28	25. 9	41	33.16	54	38.59	67	42.38
3	3. 0	16	15.25	29	25.52	42	33.47	55	39.19	68	42.50
4	3. 59	17	16 18	30	26.34	43	34.18	56	39.40	69	43. 2
5	4. 59	18	17.10	31	27.15	44	34.47	57	39.59	70	43.13
6	5. 58	19	18. 2	32	27 55	45	35.16	58	40.18	72	43.34
7	6. 57	20	18.53	33	28.35	46	35.44	59	40.36	74	43.52
8	7. 55	21	19.43	34	29.13	47	36.11	60	40 54	75	44. 0
9	8. 53	22	20.32	35	29.50	48	36.37	61	41.10	76	44. 8
10	9. 51	23	21.21	36	30.27	49	37. 3	62	41.27	78	44.22
11	10.48	24	22. 8	37	31. 2	50	37.27	63	41.43	80	44 34
12	11 45	25	22.55	38	31.37	51	37.51	64	41.57	85	44.53
13	12.41	26	23 40	39	32.1	52	38.15	65	42.11	90	45. 0

Thus have you both ſides decribed. Beſides all this, there are two ſights added, with a threed and plummet like as in other inſtruments. The threed hath a moovable bead upon it for ſpeciall uſe. The ſame threed paſſeth through the center R. quite behind the Quadrant, and is hung upon a pinne at the bottome of the Quadrant, noted with W. The reaſon of the threeds length will be ſeene when wee come to the uſes of the inſtrument.

CHAP. II.

The uſe of the Quadrant in generall.

F*Irſt upon the fore-ſide.* The limbe ſerveth eſpecially for obſervation of all neceſſary angles.

The lines AE, CD, with the Parallelogram BCEF, are to find out the Suns Azimuth in any latitude whatſoever.

The ſlope-lines within the arkes VT, cb, by helpe of the threed and bead, doe ſerve artificially to divide the line of Houres TV, into its requiſite parts; which together with TR the line of latitudes, doe ſerve to protract all plaine Dialls howſoever ſcituated.

Secondly upon the back-ſide. Note that ABC is called the *Semicircle:* AC is called the *Diameter:* AD the *Vpper quadrant:* CD the *Nether quadrant.*

The uſes of theſe are to find out the neceſſary arkes and angles, either for preparation to the Dialls deſcription, or ſerving after for the Dialls ſcituation upon the Plaine.

In all theſe uſes the threed bearing part, and therefore having a ſufficient extent of length, that being looſed it may with facility reach over either ſide of the Quadrant.

CHAP. III.

To find the Azimuth of the Sunne in any Latitude whatſoever.

Before you can make any draught of your Diall, you muſt know the ſcituation of your plaine, both for declination and inclination. The beſt way to come to the plaines declination is by helpe of the Sunnes Azimuth.

By having the Latitude of the place; The place of the Sunne in the Eclipticke, and the altitude of the Sunne above the Horizon, you may find out the Azimuth thereof in this manner.

Adde the Sunnes altitude, and your latitude together, and ſubſtract the leſſer of them from the greater: So ſhall you have the ſumme of them, and the Difference of them. With this ſumme and difference, come to your Quadrant, and according to the time of the yeare (as the lines will direct you) *Count the ſaid Summe and Difference* reſpectively, and applying the threed unto them, find out the Sunnes place in the Parallels ſerving thereto, and where the threed cuts this Parallel, obſerve the Azimuth there interſecting, for that is the Azimuth from the South, if you number it from the line whereon the ſumme was numbred.

Example 1. In the North latitude of 52 gr. 30 min. in the Summer-time the Sunne entring into ♉, and the altitude being obſerved 30 gr: 45 min.

I

I adde the latitude 52 gr. 30 min. and the Sunnes altitude 30 gr. 45 min So I find the ſumme of them 83 gr. 15 min. and ſubſtracting the leſſer of them from the greater, I find the difference of them 21 gr. 45 min. The ſumme I number in the line AE, and the difference in DC (becauſe it is in Summer) and to the termes I apply the threed, and where it croſſeth the parallel of the beginning of ♉, there I meet with *66* gr. 43 min. which is the Azimuth from the South, being reckoned from the line AE whereon the Summe was counted.

¶ *Example* 2. The latitude and Sunnes place being the ſame if the altitude had beene *9* gr. 15 min. The ſumme of the latitude and altitude would bee *61* gr. 45 min. The difference 43 gr. 15 min. and ſo the threed applyed to theſe termes would have ſhewed *96* gr. 52 min. for the Azimuth from the South.

A third Example. In the ſame Latitude of 52 gr. 30 min. in the Winter-time, the Sunne entring the tenth degree of ♏, and the altitude being *9* gr. 30 min. I would know the Azimuth of the Sun from the South. I adde the Altitude *9* gr. 30 min. to the Latitude 52 gr. 30 min. and ſo find the ſumme of them *62* gr. 0 min. And ſubſtracting the Altitude out of the Latitude, I find the Difference of them 43 gr. 0 min. The ſumme (becauſe it is in Winter) I count upon the line DC in the Quadrant, and the Difference upon AE. So the threed applyed to theſe tearmes cutteth the tenth of ♏, at 49 gr. 50 min. which is the Azimuth numbred from DC the South.

The Amplitude.

Note here by the way, That the threed applyed to the Latitude of your place numbred upon both lines AE, DC, will ſhew you, for any place of the Sunne, the due Amplitude of his Riſing or Setting, or the Azimuth whereon hee riſeth or ſetteth, if you number the ſame from the middle line noted with XZ which here repreſenteth the Eaſt and Weſt Azimuths.

Chap. IIII.

To find out the Declination of a Plaine.

THe declination of a Plaine is numbred from the South or North points towards either Eaſt or Weſt. And it is the arke of the Horizon comprehended betweene the South-North, and a line infinitely extended upon the Horizon perpendicular to the horizontall line of the Plaine; which line may be called the Axis, and the extremity of it, the Pole of the Plaines horizontall line.

To find out this declination you muſt make two obſervations by the Sunne: The firſt is of the Diſtance or angle made betweene the Axis of the horizontall line of the Plaine, and the Azimuth wherein the Sunne is at the time of obſervation. The ſecond is of the Suns Altitude. Both theſe obſervations ſhould bee made at one inſtant, which may bee done by two obſervers, but if they bee made by one, the leſſe diſtance of time betweene them, will make the worke to agree together the better.

1. For the Diſtance. Upon your Plaine draw a line parallel to the horizon, to this line apply the ſide of your Quadrant, holding it parallel to the horizon. Then holding up a threed and plummet, which muſt hang at full liberty, ſo as the ſhadow of the threed may paſſe through the center of the Quadrant, obſerve the Angle made upon the Quadrant by the ſhadow of the threed, and that ſide that lyeth perpendicular to the horizontall line, for that angle is the Diſtance required.

2. At the ſame inſtant as neere as may be, take the Sunnes Altitude; Theſe two being heedfully done, will helpe you to the plaines Declination by theſe rules following.

When you have taken the Altitude, you may find the Sunnes Azimuth by the former Chapter. Then obſerve, whether the Sunne bee betweene the Pole of the horizontall line and the { South / North } point or not.

If the Sunne be betweene them, adde the Azimuth and Diſtance together, and the ſumme of them is the Declination of the plaine.

If the Sunne be not betweene them, ſubduct the leſſer of them from the greater, and the difference ſhall be the Declination of the plaine.

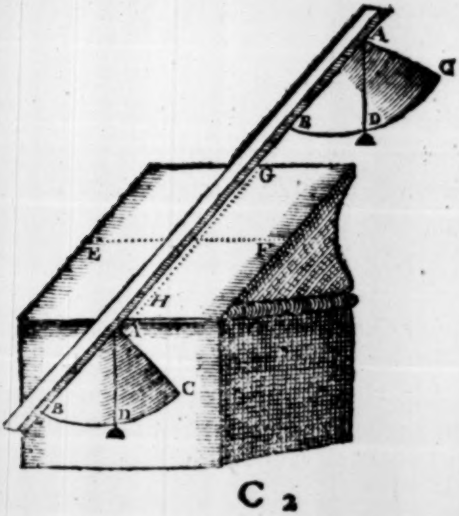
By your obſervation you may know to what coaſt a Plaine declineth.

For if the $\left\{\begin{array}{l}\text{South}\\\text{North}\end{array}\right.$ point bee in the midſt betweene the Sunnes Azimuth and the pole of the Plaines horizontall line, then doth the Plaine decline to the coaſt contrary to that wherein the ☉ is: If otherwiſe, the declination is upon the ſame coaſt with the Sunne.

Chap. V.

To find the Inclination of a Plaine.

THe Inclination of a Plaine is the angle that it maketh with the Horizon. When you have deſcribed your horizontall line upon a Plaine, as in this figure EF,



croſſe it with a perpendicular GH, for the Verticall line.

And becauſe the inclinations of the Upper and Under faces of the Plaine, are both of one quantitie in themſelves, if therefore you apply the ſide of the Quadrant noted with AB unto the verticall line of the under face, or to the under ſide of a Ruler applyed to the verticall line of the upper face, as is here ſhewed in this figure; Then ſhall the degrees of the Quadrant give you CAD the angle of inclination required.

CHAP. VI.

Of upright declining Plaines.

THoſe Plaines are upright, which point up directly into the Zenith or verticall point of the Horizon, and may be tryed by a perpendicular or plumb-line. In theſe, as in the reſt that follow, before the Houres can be drawne, two things muſt bee found; 1. *The Rectifying arke*; 2. *The Elevation of the Pole above the Plaine.*

1. *To find the Rectifying arke.*

Extend the threed from your Latitude counted in the upper Quadrant of the circle on the backeſide, to the complement of the Plaines declination numbred in the Semi-circle; ſo ſhall the threed ſhew you on the Diameter the Arke required.

2. *To find the Elevation of the Pole above the Plaine.*

Extend the threed from the Rectifying arke numbred in he upper quadrant, to your Latitudes complement taken in the Semicircle; ſo ſhall the threed ſhew upon the Diameter, the Elevation of the Pole above the Plaine.

According to theſe rules, in the latitude of 52 gr. 30 min. ſuppoſing an upright Plaine to decline 55. gr. 20 min. I find the Rectifying arke to bee 28 gr. 36 min. And the elevation of the Pole above the Plaine to be 20 gr. 10 minutes.

CHAP. VII.

In Eaſt and Weſt incliners.

THoſe plaines are called Eaſt and Weſt incliners, whoſe horizontall line lyeth full North and South, and their inclination is directly towards either Eaſt or Weſt.

1. *To find the Rectifying Arke.*

Extend the threed from your Latitudes complement taken in the upper quadrant of the Circle on the backſide, to the complement of the Plains inclination counted in the ſemicircle; ſo ſhall the threed ſhew upon the Diameter the Arke required.

2. *To find the Elevation of the Pole above the Plaine.*

Extend the threed from the Rectifying-arke croſſe it with a perpendicular GH, for the Verticall line.

And becauſe the inclinations of the Upper and Under faces of the Plaine, are both of one quantitie in themſelves, if therefore you apply the ſide of the Quadrant noted with AB unto the verticall line of the under face, or to the under ſide of a Ruler applyed to the verticall line of the upper face, as is here ſhewed in this figure; Then ſhall the degrees of the Quadrant give you CAD the angle of inclination required.

CHAP. VI.

Of upright declining Plaines.

THoſe Plaines are upright, which point up directly into the Zenith or verticall point of the Horizon, and may be tryed by a perpendicular or plumb-line. In theſe, as in the reſt that follow, before the Houres can be drawne, two things muſt bee found; 1. *The Rectifying arke*, 2. *The Elevation of the Pole above the Plaine.*

1. *To find the Rectifying arke.*

Extend the threed from your Latitude counted in the upper Quadrant of the circle on the backeſide, to the complement of the Plaines declination numbred in the Semi-circle; ſo ſhall the threed ſhew you on the Diameter the Arke required.

2. *To find the Elevation of the Pole above the Plaine.*

Extend the threed from the Rectifying arke numbred in he upper quadrant, to your Latitudes complement taken in the Semicircle; ſo ſhall the threed ſhew upon the Diameter, the Elevation of the Pole above the Plaine.

According to theſe rules, in the latitude of 52 gr. 30 min. ſuppoſing an upright Plaine to decline 55 gr. 20 min. I find the Rectifying arke to bee 28 gr. 36 min. And the elevation of the Pole above the Plaine to be 20 gr. 10 minutes.

CHAP. VII.

In Eaſt and Weſt incliners.

THoſe plaines are called Eaſt and Weſt incliners, whoſe horizontall line lyeth full North and South, and their inclination is directly towards either Eaſt or Weſt.

1. *To find the Rectifying Arke.*

Extend the threed from your Latitudes complement taken in the upper quadrant of the Circle on the backſide, to the complement of the Plains inclination counted in the ſemicircle; ſo ſhall the threed ſhew upon the Diameter the Arke required.

2. *To find the Elevation of the Pole above the Plaine.*

Extend the threed from the Rectifying-arke counted in the upper quadrant, to your latitude taken in the Semicircle; ſo the threed upon the Diameter gives the elevation of the Pole above the Plaine.

Thus in the latitude of 52 gr. 30 min. If a Plaine incline Eaſtward 40 gr. to the horizon, the Rectifying-arke will be 35 gr. 58 min. And the elevation of the Pole 37 gr. 26 min. above the plaine.

CHAP. VIII.

In North and South incliners.

SUch Plaines are called North and South incliners, whoſe horizontall line lyeth full Eaſt and Weſt, and their inclination is directly upon either North or South.

1. For the Rectifying-Arke.

There is no uſe of it in theſe plaines, becauſe they all lye directly under the Meridian of the place.

2. To find the Elevation of the Pole above the Plaine.

If the inclination be toward the South, adde the inclination to your latitude; for the ſumme is the Elevation of the pole above the Plaine. If the ſumme exceed 90 degrees, take it out of 180, and the ſupplement gives you the Poles elevation.

If the inclination bee Northward, compare the inclination with your latitude, and ſubduct the leſſer out of the greater: the Difference is the elevation of the Pole above the Plaine, If there bee no difference, it is a Direct polar Plaine.

CHAP. IX.

In declining Incliners.

THoſe Plaines are called *Declining incliners*, whoſe horizontall line declineth from the Eaſt or Weſt, towards either North or South, and their inclination alſo deflecteth from the coaſts of North and South towards either Eaſt or Weſt.

The beſt way to find the Rectifying-arke, and the Poles elevation for theſe Plaines, will be

Firſt, to referre them to a *New latitude*, wherein they may lye as Eaſt or Weſt incliners. For which purpoſe you are firſt to find out an Arke, which in reſpect of its uſe may fitly be called, *The Proſthaphæreticall arke*, it is found by this rule:

¶ Extend the threed from the complement of the Plaines declination counted in the upper quadrant, to the inclination numbred in the Semicircle; ſo the threed ſhall give you upon the Diameter the Proſthaphæreticall-arke required.

This Proſthaphæreticall-arke is to be uſed as the Inclination was in the precedent Chapter. For,

If the Plaine doe incline towards the South, it muſt be added to your Latitude: and ſo the ſumme (if leſſe then 90 degrees) gives you the *New Latitude*: but if the ſumme bee greater than 90, then the reſidue, or ſupplement of it to 180 degrees will be the *New Latitude* required.

If the Plaine incline toward the North, compare this Proſthaphæreticall-arke with your Latitude, and ſubduct the leſſer of them out of the greater; So the Difference ſhall give you the *New Latitude*. If there be no difference, it is a declining *Polar plaine*.

Secondly, it will be required to know what Inclination theſe Plaines ſhall have in this their *New latitude*; and that is done by this rule:

¶ Extend the threed from the Proſthaphæreticall-arke taken in the upper quadrant to the Plaines declination counted in the Semicircle: ſo the threed ſhewes on the Diameter, the *New-inclination* in their *New latitude*.

Being thus prepared, you may now proceed as in Eaſt and Weſt incliners you did before.

1. *To find the Rectifying-Arke.*

Extend the threed from the New latitudes complement taken in the upper quadrant, to the New-inclinations complement numbred in the Semicircle; ſo the threed upon the Diameter ſhewes the Arke required.

2. *To find the Elevation of the Pole above the Plaine.*

Extend the threed from the Rectifying-arke in the *Vpper-quadrant* to the *New latitude* in the Semicircle; ſo the threed upon the Diameter gives the Elevation of the pole above the plaine.

According to theſe rules, ſuppoſing a Plaine to incline towards the North 30 degrees, and to decline from the South towards the Weſt 60 degrees in the latitude of 52 gr. 30 min. Firſt I find the Proſthaph:

arke 60 gr. 6 min. and becauſe the Plaine inclineth toward the North; I compare this arke with the Latitude of the place, and taking it out of the Latitude there remaineth 36 gr. 24 min. for the *New Latitude*. Then I find the *New inclination* to bee 25 gr. 40 min. and ſo the Rectifying-arke 59 gr. 8 min. and the Elevation of the Pole above the Plaine to be 32 gr. 20 minutes.

CHAP. X.

To draw the Houre-lines upon the Horizontall, the full North or South plaines, whether ſtanding upright or inclining.

IN the foure laſt Chapters we have ſeene the uſes of the Circle on the backe-ſide of the Quadrant: in this and the next Chapter we ſhall ſhew the uſe of TR the line of latitudes, and of TV the line of Houres; which two lines with the helpe of the limbe VCTB, and of the threed and Bead, will ſerve to pricke downe any Diall, by the Precepts hereafter delivered. And firſt we begin with thoſe Plaines which have no declination, whoſe Poles lye directly under the Meridian of the place; of which ſort are the Horizontall, the Erect South and North plaines, with all Incliners looking directly North or South.

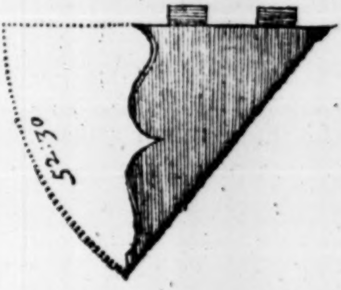
Having then by the former Precepts found the

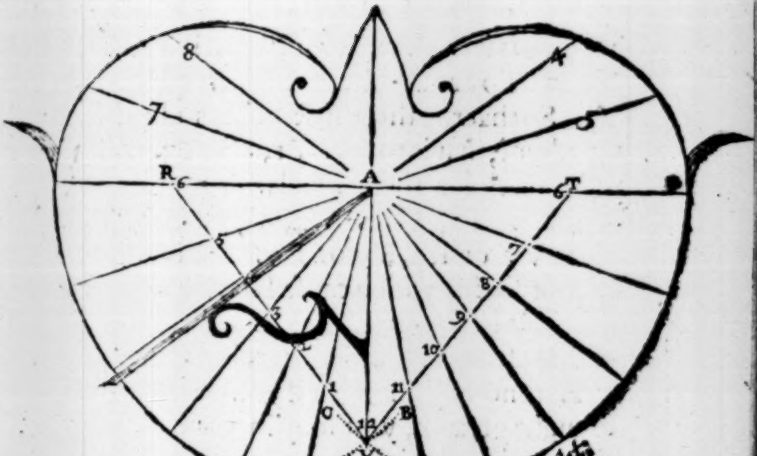
Elevation of the pole above your Plaine, you may begin your draught in this manner.

Firſt, Draw the line RAT of ſufficient length, and out of the line of Latitudes in your Quadrant, take off the Elevation of the pole above the plaine, and pricke it downe from the point A, unto R and T both wayes.

2. Take the line of Houres TV alſo out of the Quadrant, and with that extent of your Compaſſes upon R and T as upon two centers, draw the arkes BV and CV, croſſing each other in V; and draw the lines RV and TV: then comming to your Quadrant againe;

3. Apply the threed to every houre point in the limbe VT or CB, as firſt to s, or r, ſo ſhall it cutte the Line of houres TV in 1; Then take off with your Compaſſes T 1, and pricke it downe here from V to 1, and from T to 7. Again, Apply your threed to the next houre in the limbe at n or m, it will cut the Line of houres TV in 2 take off T 2, and prick it down here from V to 2, and from T to 8. So againe, the threed applyed to the third houre at y, or u, cuts the line TV, in 3; take off T 3, and pricke it downe here from V to 3, and from T to 9. In like manner, the threed applyed to the fourth houre at o, or i, will cut the line TV in 4 take off T 4, and pricke it downe here from V to 4, and from T to 10. So alſo the threed laid upon the fifth houre at c, or a, cutteth TV in 5; take off T 5, and prick it downe here from V to 5, and from T to 11. Thus are all the Houres pricked downe.





An horizontall Diall to 52 gr: 30 m: latit.

Laſtly then, laying your Ruler to the center A, through each of theſe points, you ſhall draw the houre-lines A7, A8, A9, A10, A11, AV which is 12, A1, A2, A3, A4, A5, RAT is the line of the two ſixes. So having 12 houres, which is halfe the Diall, drawne, you may extend the neceſſarie lines, as many as you will, beyond this center, as 5A5, 4A4, 7A7, 8A8, &c.

In the ſame manner may the halfe houres bee pricked downe and drawne, by applying the threed to the halfe houres in the limbe, &c.

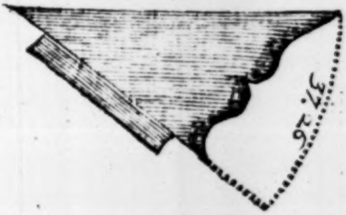
And note alſo that in theſe Plaines before mentioned; As the extent from V to 1, is the ſame with that from T to 7, ſo likewiſe is it the ſame with V11, R5; And as V2 is the ſame with T8, ſo likewiſe is it the ſame with V10, R4: So likewiſe V9 and T9 are all one, and both equall to R3 and V3. So that the three firſt houres taken from the Quadrant, that is to ſay, T1, T2, T3, will give all the houres for theſe Dialls. T1, gives V1, V11, R5, T7. T2, gives V2, V10, R4, T8. T3, gives V3 or R3, V9 or T9. But in other Plaines it is not ſo, for which cauſe I have rather ſet downe this way before at length, as a direction for what comes after, for that is generall.

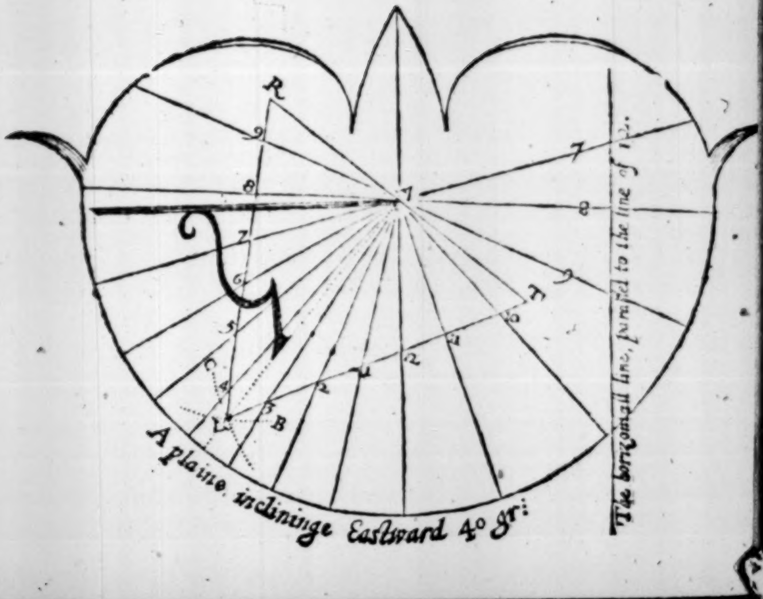
Here note againe, that if you deſire to make your draught greater, you may in your deſcription either double or triple every length which you take in your Compaſſes. And ſo I proceed to all declining Plaines.

CHAP. XI.

To draw the Houres upon all ſorts of declining Plaines, whether erect or inclining.

BY the former precepts you muſt firſt get the Rectifying arke, with the Elevation of the pole above the Plaine. After they are had, you may pricke downe the Houre points in this manner following, little differing from the former.




R
9
8
7
6
5
C
4
3
L
B
2
1
12
11
10
T
9
8
7
A plaine inclininge Eastward 40 gr:
The horizontall line, parallel to the line of 1

1. As before; Upon the line RAT, ſet off the Elevation of the pole above the plaine, being taken out of the line of latitudes in the Quadrant, from A both wayes, to R and T.

2. Take the line of Houres TV out of the Quadrant, and with that extent upon R and T as upon two centers, deſcribe the two arkes BV and CV croſſing at V, and draw the lines RV, TV, and AV. Thus farre we goe along with the laſt Chapter.

3. If we take the example in the ſeventh chapter, that plaine is the upper face of an Eaſt incliner, whoſe Elevation is 37gr. *26* min. and ſo much doth this line TA reach unto in the line of Latitudes: the Rectifying arke is 35gr. 58 min. This arke I number below in the limbe of the Quadrant ES, and thereto applying the threed I obſerve in the upper limbe VcbT which of the Houres and where it cutteth, I find it to cut the ſlope line o u in the point P, to this point P I ſet the Bead, which by this meanes is rectified and fitted to the deſcription of the Diall.

Here you ſee the uſe of the Bead, and the reaſon why this arke counted upon the limbe is called the Rectifying arke: and here bee carefull that you ſtretch not the threed.

4. The threed and Bead being thus placed and rectified, you ſhall ſee the threed to cut the line TV at *a* upon the Quadrant; take T*a* in your Compaſſes, and pricke it downe here from V to 12, and from R to *6*.

Here by the way obſerve, that becauſe this plaine is an Eeaſt-incliner, the face of it looketh toward the Weſt, and then if you imagine the true ſcituation of this Diall upon the plaine whereon it muſt ſtand, you will eaſily conceive that the line of 12 is to ſtand on the right hand from the line AV. and ſo the line of *6* on the left hand, whereas if this plaine had faced toward the Eaſt, the line of **12** muſt have ſtood on the left hand, and *6* on the right hand. Your owne conceit, together with the precepts of the chapter following, muſt helpe in this, and in other things concerning the right ſcituating of the lineaments of your Diall.

To proceed then,

In the ſame manner muſt you apply the Bead to every houre line, as in the next place I remove it to the line y m in the Quadrant, and then I ſee it to cut the line TV in b; I take I b in my Compaſſes, and with it doe pricke downe from V to 1, and from R to 7. Againe, the Bead being applyed to the lines nr, ſb, the threed will cut the line TV upon the Quadrant in c and d; I take the points TC, Td, in my Compaſſes, and pricke them downe from V to 2 and 3, and from R to 8 and *9*. Then againe, the Bead applyed to the lines ei, Va, the threed will cut the line TV in the points e and o; I take then Te and Tf, and pricke them downe from V to 11 and 10, and from R to 5 and 4.

5. Laſtly, lay your rule to A, and draw A 10, A 11, A 12, A 1, A 2, A 3, A 4, A 5, A *6*, A 7, A 8, A *9*.

A9. Thus have you twelve houres, and if you extend theſe beyond the Center, you ſhall have the whole 24 houres, of which number you may take thoſe that ſhall bee fit for the Plaine in this ſcituation.

The halfe houres may thus bee pricked on and drawne alſo, by applying the Bead to the halfe houres pricked downe in VcbT the upper limbe of the Quadrant, for ſo the threed will give you the halfe houre points upon the line TV, which may be taken off, and ſet downe upon the Diall as the houres themſelves were.

Chap. XII.

How to place the Diall in a right Scituation upon the Plaine.

After the houre-lines are drawne by the laſt Chapter, they are to be placed in a right ſcituation upon their Plaine. Which to doe, upon ſome Plaines is more difficult than the Deſcription of the Diall it ſelfe. To give ſome directions herein, I have added this Chapter, where you have 9 Queſtions with their Anſwers, giving light ſufficient to what is here intended and required: but firſt be admoniſhed of three things.

1. That the inclination mentioned Chap. 8. is the very ſame in Uſe with the Proſthaphæreticall arke mentioned Chapter 9. And therefore when I

mention the Proſthaphæreticall arke, becauſe it is of moſt frequent uſe, you muſt remember I meane both the Proſthaph: arke, Chap.9, and the Inclination, Chap.8.

2. That theſe rules, though given primarily for places of North-latitude, lying within the Temperate, Torrid, and Frigid Zones, yet are alſo as true, and may bee applyed to all places of South-latitude, if we exchange the names of North and South, for South and North.

Here by the way note, that the North part of the Torrid Zone extendeth from 0 degrees of latitude to 23 gr. 30 min. the Temperate Zone reacheth from 23 gr. 30 min. to 66 gr. 30 min. the Frigid Zone extendeth from 66 gr. 30 min. to 90 gr. of latitude. And ſo I come to the 9 Queſtions.

1. *What Pole is elevated above the Plaine.*

Upon all Upright plaines declining from the North: Upon the upper faces of all Eaſt or Weſt incliners: Upon the upper faces of all North-incliners, whoſe Proſthaph: arke is leſſe than the latitude of the place: On the under faces of all North-incliners, whoſe Proſthaph: arke is greater then the Latitude of the place; and on the upper faces of all South-incliners, The North pole is elevated. And therefore contrarily,

Upon all upright Plaines declining from the South: On the under faces of all Eaſt and Weſt, and South incliners: On the under faces of all North-incliners, whoſe Proſthaphæreticall arke is leſſe than the Latitude of the place: On the upper faces of all North-incliners, whoſe Proſthaph: arke is greater than the Latitude of the place, The South pole is elevated.

2. What part of the Meridian aſcendeth or deſcendeth from the Horizontall line of the Plaine?

In all Upright plaines the Meridian lyeth in the Verticall line, and if they decline from the South it deſcendeth, if from the North it aſcendeth.

Upon both faces of Eaſt and Weſt Incliners the Meridian lyeth in the Horizontall line.

In all North-incliners, the North part of the Meridian aſcendeth, the South part deſcendeth: in all South incliners the South part of the Meridian aſcendeth, the North part deſcendeth: upon both upper and under faces. And if theſe North and South incliners be direct, then the Meridian lyeth in the Verticall line, and ſo maketh a right angle with the Horizontall line: but if they decline, then the Meridian on the one ſide maketh an acute angle with the horizontall line.

3. To which part of the Meridian is the ſtyle with the ſubſtyle to be referred, as making with it an acute angle?

The ſtyle is the cocke of the Diall; the ſubſtyle is the line whereon it ſtandeth, ſigned out in the former deſcriptions by the letters AV.

In all Plaines whereon the North pole is elevated, it is referred to the North part of the Meridian, and maketh an acute angle therewith.

In all Plaines whereon the South pole is elevated, it is referred to the South part of the Meridian, and is to make an acute Angle therewith.

Except here only thoſe South-incliners, whoſe Proſthaph: arke is more than the complement of your Latitude: for on theſe plaines the ſubſtyle ſtandeth on that part of the Meridian, whoſe denomination is contrary to the Pole elevated above the Plaine. For on the upper faces the North pole is elevated, but the ſubſtyle ſtandeth toward the South end of the Meridian: and on the under faces the South pole is elevated, but the ſubſtyle lyeth toward the North end of the Meridian.

Note here, that in South-incliners whoſe Proſthaphæreticall arke is equall to the complement of your Latitude, the ſubſtyle lyeth ſquare to the Meridian upon the line of *6* a clocke; which line in ſuch plaines alwayes lyeth perpendicular to the Meridian line. Amongſt theſe falleth the Equinoctiall plaine.

4. *On which ſide of the Meridian lyeth the ſubſtyle?*

In all direct plaines it lyeth in the Meridian. In all Decliners it goeth from the Meridian toward that coaſt which is contrary to the coaſt of the plaines declination.

And ſo doe all houres alſo goe upon the Plaine to that coaſt which is contrary to the coaſt whereon they are; As all the morning or Eaſterne houres goe to the Weſterne coaſt of the Plaine, and all the Evening or Weſterne houres goe to the Eaſterne coaſt of the Plaine. Which being obſerved will bee a great helpe to place them aright.

5. *What plaines have the line of* 12 *upon them, and which not?*

All upright Plaines, in all latitudes whatſoever, declining from the South have the line of 12; and decliners from the North in the temperate Zone have it not, but in the other Zones they alſo have it.

The upper faces of Eaſt and Weſt incliners in all Latitudes have it, the underfaces have it not.

The upper faces of all North incliners whatſoever have it; their under faces in the Temperate Zone want it, in the Frigid Zone have it, and in the Torrid Zone likewiſe if the Proſthaph: arke bee greater than the Sunnes leaſt North Meridian altitude, but if it be leſſe they want it alſo.

For South incliners, conſider the Sunnes greateſt and leaſt Meridian altitude upon the South coaſt. For if the Proſthaphæreticall arke bee ſuch as falleth betweene them, that is, if it be greater than the leaſt, or leſſe than the greateſt, then have both ſides the line of 12 upon them; but if it be leſſe than the leaſt, then doth the Underface want it univerſally, and the upper face alone hath it; if greater than the greateſt, then doth the Upper face want it, and the underface alone hath it: Except in the Frigid Zone where the upper face hath it alſo, by reaſon of the Sunnes not ſetting there for a time.

6. *Whether the North or South part of the Meridian ſerveth for the line of* 12?

In thoſe Plaines that have the line of 12, where the North pole is elevated, there the North part of the Meridian ſerveth for 12. and where the South pole is elevated, there the South part of the Meridian ſerveth for the line of 12 or midday.

Except, in all Latitudes, the under faces of thoſe South incliners, whoſe Proſthaphæreticall arke falleth betweene the Sunnes greateſt and leaſt Meridian altitudes, for in them the South pole is elevated, but the North part of the Meridian ſerveth for the line of 12.

Except in ſpeciall thoſe Upright Plaines in the Torrid-zone which looke toward the North, and the Under faces of North-incliners alſo, whoſe Proſthaphæreticall arke is greater than the leaſt North-meridian-altitude; for theſe have the South or lower part of the Meridian ſerving for 12, though the North pole be elevated.

7. *Which way the ſtyle pointeth, and how it is to bee placed?*

In Plaines where the North pole is elevated, it pointeth up towards it; and where the South pole is elevated, it pointeth downe towards it.

The ſtyle lyeth perpendicularly over the ſubſtyle, noted in the former figures with AV, and is to be elevated above it to ſuch an angle as the Elevation of the pole above the Plaine ſhall be found to be by the *6*, 7, 8, and *9* Chapters.

8. *When is it that that part of the Meridian next the ſubſtyle, and the line of twelve doe goe contrary wayes?*

In all Latitudes, Upon the upper faces of South-incliners, whoſe Proſthaphæreticall arke is greater than the complement of the Latitude, but leſſe than the Sunnes greateſt South Meridian altitude: And on the Under faces of thoſe South-incliners alſo, whoſe Proſthaph: is leſſe than the complement of the Latitude, but greater than the Sunnes leaſt South meridian altitude: In the Torrid-Zone alone you muſt adde hither alſo, North upright Plaines, and thoſe North-incliners on the Under-face, whoſe Proſthaphæreticall-arke is greater than the leaſt North-meridian altitude of the Sun; for theſe have the line of midday ſtanding on that coaſt which is contrary to the coaſt of that part of the Meridian next the ſubſtyle, and none elſe. The line of 12. I call here the line of midday because in the Frigid-zone, where the Sunne ſetteth not in many dayes together, there are two twelves, the one anſwering to our midday, and the other to our midnight: and ſo all Upper faces of South-incliners, whoſe Proſthaphæreticall arke falleth betweene the leaſt and greateſt South meridian altitudes, have there two 12 a clocke lines upon them.

9. *How much the Meridian line aſcendeth or deſcendeth from the Horizontall line?*

The quantity of the Angle is to be found upon the circle on the back-ſide of your Quadrant, in this manner;

Extend the threed from the complement of the Plaines inclination taken in the lower Quadrant, to the complement of the Plaines declination counted in the Semicircle, and the threed will ſhew you upon the Diameter, the degrees and minutes of the Meridians Aſcenſion or Deſcenſion.

In the example of the 9. Chapt. taking the Upper face of that Plaine, I find the Meridian to aſcend above the Horizontall line 33 gr. 41 minutes.

¶ *Theſe directions are ſufficient for the beſtowing of every line into its proper place and coaſt. As may bee ſeene in the Example of the ninth Chapter.* For,

Firſt, upon the upper face of that North incliner, becauſe his Proſthaph: arke 16 gr. 6 min. is leſſe than 52 gr. 30 min. the Latitude of the place, therefore the North pole is elevated above it: by the Anſwer to the firſt Queſt.

2. Becauſe it is a North-incliner, therefore the North part of the Meridian aſcendeth above the Horizontall line, by the anſwer to the ſecond Queſtion.

3. Becauſe the North pole is elevated, therefore the Style with the ſubſtyle maketh an acute angle with the North end of the Meridian, by the Anſwer to the third Queſtion.

4. Becauſe this Plaine declineth toward the

Weſt, therefore the ſubſtyle lyeth on the Eaſt-ſide of the Meridian, and ſo doe the houres of the afternoone: by the Anſwer to the fourth Queſtion.

5. This Plaine, being the Upper face of the North-incliner, will have the line of 12 to bee drawne upon it, by the Anſwer to the fifth Queſtion.

6. Becauſe the North Pole is elevated, therefore the North part of the Meridian ſerveth for the line of 12: by the Anſwer to the ſixt Queſtion.

7. Becauſe the North pole is elevated, therefore the ſtyle pointeth upward toward the North pole; by the Anſwer to the ſeventh Queſtion.

8. That part of the Meridian next the Subſtyle, and the line of 12 are both one, and ſo therefore goe both one way: by the Anſwer to the eight Queſtion.

9. By the ſecond the Meridian line aſcendeth, and the quantity of the aſcent is 33 gr. 41 min. above the Horizontall line: by the Anſwer of the ninth Queſtion.

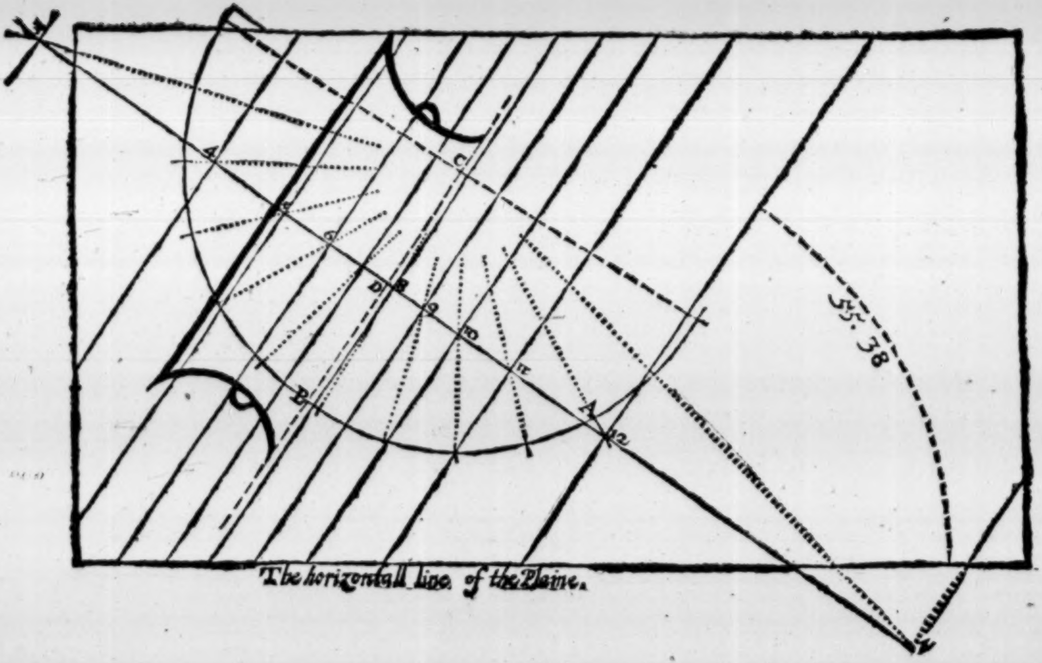
Thus you ſee every doubt cleared in this example: the like may be done in all others.

Chap. XIII.

The making and placing of Polar Plaines.

POlar Plaines are thoſe North incliners, whether direct or declining, that lye in the Pole, and ſo have no Elevation of the Pole above them, as the direct North

Place this Diagram betweene folio 32. and 33.



and South polar, the Eaſt and Weſt upright Plaines, and infinite others declining betwixt both. You may know them by the 8 and 9 Chapters, as is there intimated.

Theſe Plaines may have Dialls deſcribed upon them by this Quadrant, but the better way is the common way, to protract them by an equinoctiall circle, for otherwiſe the ſtyle will be alway of one diſtance from the Plaine, be the Diall greater or leſſer.

The Polar plaines that decline, before they can be deſcribed, muſt have their *New-inclination* known, and then their delineation will be eaſie, the manner of it may be ſeene in this Example.

Suppoſe the upper face of a North-inclining Plaine, lying in the Latitude of 52 gr. 30 min. to decline from the South toward the Eaſt 68 gr. and to incline towards the North 73 gr. 57 min. you ſhall find by the ninth Chapter, the Proſthaph: arke to be 52 gr. 30 min. the ſame with the Latitude of the place, and therefore you may conclude this plaine to be Polar. By the ſame Chapter you ſhall find the New inclination to be 63 degrees.

When you have theſe you may draw your Semicircle AB4, and divide it into 12 equall parts for the houres: ſo ſigning the new-inclination 63 degrees from A to B, draw CB : and ſuppoſing the altitude of your ſtyle to be CD, through D draw the perpendicular D 12; and where the lines drawne from C through the diviſions of the ſemicircle doe cut the line D 12, there raiſe perpendi-

culars

culars for the houres, and ſo finiſh it up as the manner is. The ſtyle lyeth directly over and parallel to the ſubſtyle CB, & the diſtance of it from the plain is CD, and in this Example the ſubſtyle CB ſtandeth from the line of 12 Weſtward, becauſe the plaine declineth Eaſtward, according to the rules in the former Chapter, and ſo doe the morning houres alſo.

For the placing of the Diall in a true ſite upon the Plaine, you ſhall find by the anſwer to the *9* Queſt. in the former Chapter, that the Meridian aſcendeth 55 gr. 38 min. for other neceſſaries, the precepts of the former Chapter will direct you. Onely obſerve, that in Upright Eaſt and Weſt plaines, the line of *6* is alwayes the ſubſtyle, and it
aſcendeth above the North end of the Horizontall line, as much as the Latitude of
the place commeth to.

FINIS.

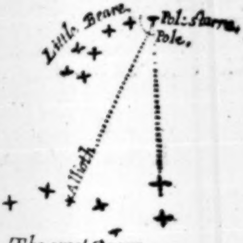
AN APPENDIX

Shewing a ready way to find out the Latitude of any place by the Sunne.

BEcauſe in the third Chapter, and quite through this Treatiſe, the Latitude of the place is ſuppoſed to bee knowne, whenas every one perhaps cannot tell which way to find it out; I thought good therefore to adde this *Appendix* as a ready helpe to ſhew how it may bee attained ſufficiently for our purpoſe. Know then that for the finding out of the Latitude of a place by the Sunne, theſe things are required.

1. *To find the Meridian line.*

The readieſt way to find the Meridian line is by the North-ſtarre. This ſtarre is within 2 degr. 37 min. of the North-pole. The North-pole lyes very neere betweene Allioth, or the root of the great Beares tayle, and this ſtarre; You may therefore imagine where the Pole is, if you conceive a right line drawne from the Pole-ſtarre to Allioth, and by your imagination ſuppoſe ⅔ parts of the diſtance of the next ſtarre of the little Beares taile from the Pole-ſtarre towards *Allioth*, for there is the very Pole-point. Now then if you ſet up two poles aſlope, and from the tops of them hang two cords with weights at the ends of them, and turne them till you ſtanding on the South-ſide of them may ſee them both together with the Pole-point, as it were all in one line, then be ſure theſe two cords doe hang in the Meridian line, or very neere it, yea ſo neere it, that though you ſhould erre 3 degrees herein (wherein you need not to erre one degree) yet will not the Meridian altitude in theſe Climates (eſpecially more Northward) faile you above 3 minutes, which is neere enough to our purpoſe. I have here given you the chiefe ſtarres of the great and little Beares, that by them you may come to know the ſtarres uſed in this obſervation, and ſo find the very Pole-point it ſelfe.



The great Beare.

2. *To find the Sunnes Meridian altitude.*

Obſerve diligently about noone when the ſhadow of the South cord ſhall fall upon the North cord, for then is the Sun in the Meridian. At that inſtant obſerve the Suns altitude ſtedily and carefully, for that is the Meridian and greateſt altitude of the Sun for that day.

To

3. To find the Sunnes declination.

For this purpoſe the limbe hath the characters of the 12 Signes fixed to each 30 degree, and a ſcale of declinations under the limbe noted with MN. The Scale is divided by this table; for looke what degr. and min. of the Eclipt. doe anſwer to the degr. of declination in the table, the ſame are to be numbred in the limbe, and by a ruler applyed to them, the degrees of declination are drawne upon the Scale.

A Table to make the Scale for the declination of every part of the Eclipticke.

Degr. of decl.	Deg. of the ecl.	Degr. of decl	Deg. of the ecl.	Degr. declin.	Degr. eclipt.	Degr. declin.	Degr. Eclipt	Degr. declin.	Degr. Eclipt	Degr. declin.	Degr. Eclipt
0. 0	0. 0	4. 0	10. 4	8. 0	20.26	12. 0	31.26	16. 0	43.44	2. 0	59. 4
15	0. 38	15	10. 43	15	21. 6	15	32. 9	15	44 34	15	60.14
30	1. 15	30	11.21	30	21.46	30	32. 52	30	45.25	20	61.26
45	1. 53	45	11.59	45	22. 26	45	33.36	45	46.17	45	62. 41
1. 0	2. 31	5. 0	12.37	9. 0	23. 6	13. 0	34.21	17. 0	47. 9	20. 0	46.00
15	3. 8	15	13.16	15	23.46	15	35. 5	15	48. 3	15	65.22
30	3. 46	30	13.54	30	24. 27	30	35.50	30	48.57	30	66.48
45	4. 24	45	14.33	45	25. 8	45	36.35	45	49.52	45	68.26
2. 0	5. 1	6. 0	15.12	10. 0	25. 49	14. 0	37. 21	18. 0	50 48	22. 0	69.58
15	5. 39	15	15.51	15	26. 30	15	38. 7	15	51.45	15	71.44
30	6. 16	30	16.30	30	27. 12	30	38.54	30	52.42	30	73.41
45	6. 55	45	17. 8	45	27.52	45	39.41	45	53.43	45	75.53
3. 0	7. 33	7. 0	17.48	11. 0	28.36	15. 0	40.28	19. 0	54.44	23. 0	78.30
15	8. 10	15	18.27	15	29.17	15	41.16	15	55.47	15	81.52
30	8. 48	30	19. 6	30	30. 0	30	42.05	30	56.50	30	90. 0
45	9. 26	45	19.46	45	30.43	45	42.54	45	57.56	Finis.	

Before you can find the Declination, you muſt know the Sunnes place, and for ſuch as know not the uſe of the Aſtronomicall tables, an Almanacke will ſerve, where for every day at noone, you ſhall find the Sunnes place in ſignes, degrees and minutes. The degr. and min. muſt bee numbred in their Signes upon the limbe, and the threed applyed thereto will ſhew the declination anſwerable. As for example. September 21. 1637 in the Almanack for this yeare, the Sunne is found to be in 8 gr. 23 min. of ♎. In the Quadrants limbe I looke for the Signe ♎ and number there, 8 gr. 23 min. whereto apply the threed, I find it to cut in the ſc[illegible]e of Declinations 3 gr. 20 min.

4. *By the Meridian Altitude, and declination of the Sun had; how to find the Latitude of the place, or the Elevation of the Pole above the Horizon.*

Compare the Sunnes Meridian altitude and declination together, and if the Sunne be in a North Signe as ♈♉♊♋♌♍, then ſubſtract the declination out of the Meridian altitude, ſo ſhall the difference give you the height of the Equinoctiall. But if the Sun be in the South Signes, as ♎♏♐♑♒♓, then adde the declination to the Meridian altitude, ſo ſhall the ſumme give you the height of the Equinoctiall, which being taken out of the Quadrant or 90 degrees, leaveth the Latitude of your place, or the Elevation of the Pole above your Horizon.

For Example. Upon the 21 of September 1637. I obſerved the Sunnes altitude in the Meridian to be 34 gr. 10 min. Upon which day I find the

Sunnes place to be (as before) 8 gr. 23 min. of ♎, and the declination 3 gr. 20 min. And becauſe the Sun is in a South ſigne, I adde this declination and Meridian altitude together; the ſumme 37 gr. 30 min. is the altitude of the æquator, and this taken out of 90 degrees leaveth 52 gr. 30 min. for the Latitude of **Coventrie.** North pole elevated in [illegible]
30
[illegible] minutes [illegible] is [illegible] from ye first point in ye [illegible]
[illegible] 45 minutes.

[illegible] is sited in ye degr: of Latitude 53 & 20 [illegible]
[illegible] minutes.

6 min

[illegible] ye [illegible] elevation [illegible] from ye equator to be 53 dgr. 25
[illegible] ye first point in ye [illegible] 19 degrees & 25 minutes.

[illegible] ye pole is elevated 53 & 25 mi-
[illegible] 25 [illegible]

[illegible] ye pole
is elevated 53 degr
40
minutes in Lat
[illegible] longitude 19
[illegible] 22 minutes

[illegible] from
27 minute

Origina
Def

nal

efective

6 mi

w. 25

will ſerve, where for every day at noone, you ſhall find the Sunnes place in ſignes, degrees and minutes. The degr. and min. muſt bee numbred in their Signes upon the limbe, and the threed applyed thereto will ſhew the declination anſwerable. As for example. September 21. 1637 in the Almanack for this yeare, the Sunne is found to be in 8 gr. 23 min. of ♎. In the Quadrants limbe I looke for the Signe ♎ and number there, 8 gr. 23 min. whereto apply the threed, I find it to cut in the ſcale of Declinations 3 gr. 20 min.

4. *By the Meridian Altitude, and declination of the Sun had; how to find the Latitude of the place, or the Elevation of the Pole above the Horizon.*

Compare the Sunnes Meridian altitude and declination together, and if the Sunne be in a North Signe as ♈♉♊♋♌♍, then ſubſtract the declination out of the Meridian altitude, ſo ſhall the difference give you the height of the Equinoctiall. But if the Sun be in the South Signes, as ♎♏♐♑♒♓, then adde the declination to the Meridian altitude, ſo ſhall the ſumme give you the height of the Equinoctiall, which being taken out of the Quadrant or 90 degrees, leaveth the Latitude of your place, or the Elevation of the Pole above your Horizon.

For Example. Upon the 21 of September 1637. I obſerved the Sunnes altitude in the Meridian to be 34 gr. 10 min. Upon which day I find the

Sunnes place to be (as before) 8 gr. 23 min. of ♎, and the declination 3 gr. 20 min. And becauſe the Sun is in a South ſigne, I adde this declination and Meridian altitude together; the ſumme 37 gr. 30 min. is the altitude of the æquator, and this taken out of 90 degrees leaveth 52 gr. 30 min. for the Latitude of **Coventrie.** North pole elevatio in [illegible]
[illegible] 30 minutes [illegible] is seated from ye first point in ye [illegible]
[illegible] 45 minutes.

[illegible] is sited in ye degr. of Latitude 53 & 20 [illegible]
& [illegible]

6 min
[illegible] ye [illegible]ation wch is observed fro ye Equator to be 53 degr. 25
[illegible] ye first point in ye [illegible] degrees & 25 minutes.

[illegible]ingham ye pole is elevated 53 & 25 mi
[illegible] [illegible] 25 minutes.

[illegible] ye pole
is
elevated 53 degr
40
minutes in Lat
[illegible] longitude 19
35 & 22 minutes

& from
27 minute